APPENDIX 1 – AUTOMATION AND CONTROL SYSTEMS – TABLE OF CONTENTS

APPENDIX 1 – AUTOMATION AND CONTROL SYSTEMS – SCHEDULE OF CHANGES – VERSION 7

As a guide only, attention is drawn to changes that have been made in the following clauses since the last revision:

Table 1 Change log

Section	Changes
General	Changing of terminology from CBACS to Engineering Technology
1.0 Acronyms	Added terms: - ICN - DX - VAV - VRF - VRV Removed terms: - Cardax
2.2.1 Project Kick-off and Engagement	New section added
2.4 Physical Infrastructure 2.5 Network Topology 2.6 Supporting Services	Section split into multiple headings – new sub-sections added.
2.5.2 TCP/IP Ethernet Network	Update to network cabling - CAT6A with purple sheath Clarification of Layer 2 protocols only
2.5.3 Field Network Configuration	Specification for RS485 cables to be Belden (or approved equivalent)
2.5.4 BMS LAN	New section added
2.6.2 Uninterruptable Power Supply (UPS)	Automatic bypass for UPS failure and/or maintenance purposes.
2.7 Software	Removal of requirement for backup copies of software and documentation saved to CBACS NAS.
2.7.1 System passwords	Temporary passwords to be allocated by EM Engineering.
2.8 Naming convention	Updated for consistency
2.9 Alarm Management	Alarm matrix removed
2.10.15 Lift Systems	Update to align with Section E.5 Lift Design Standards
2.10.21 Differential Pressure Sensors	New section added
2.10.22 Temperature Well Probes	New section added
2.12 Graphical Standards	Update to requirements – new sub-sections added.
3.2 Standards and Reference Material	Inclusion of additional standards
Section 2.0 Removed sub-headings	BACnet Alarms & Alarm management CAMS Alarm Configuration Commissioning
3.3.2 LSS Control Panels	Section added for Programmable Controllers & Gas Detection Controllers
3.9.1 Oxygen & Gas Sensors	Section added
3.10 Safety Functions	Section added on safety functions.
4.0 Documentation	New section added

1.0 ACRONYMS & TERMS OF REFERENCE

Table 2 Acronyms & Terms of Reference

Term	Definition
BACnet	BMS communication protocol
BMS	Building Management System
BTL	BACnet Testing Laboratories
CBACS	Campus Building Automation and Control System
CAMS	Critical Alarm Management System
CPI	Critical Plant and Infrastructure
CUE	Critical User Equipment – School or Faculty Fridges/Freezers/Incubators
DX	Direct Expansion
EM Engineering	UNSW Estate Management Engineering
FAT	Factory Acceptance Test
FDD	Fault Detection Diagnostics
HAZID	Hazard Identification
HAZOP	Hazard and Operability
HLI	High Level Interface
HMI	Human Machine Interface
I/O	Input / Output – Field monitoring and control devices
IoT	Internet of Things
IAQ	Indoor Air Quality
ICN	Integrated Communications Network
IST	Integrated System Test
LLI	Low Level Interface
LSS	Life Safety System and Gas Detection
Modbus	Industry communication protocol
MS/TP	Master Slave / Token Pass – BACnet communication protocol
MTTR	Mean Time to Repair
NAS	Network Attached Storage
OEM	Original Equipment Manufacturer
O&M	Operation and Maintenance
PLC	Programmable Logic Controller
SAT	Site Acceptance Test
SIF	Safety Instrument Function
TCP/IP	Network Protocol
VLAN	Virtual Local Area Network
VAV	Variable air volume
VRF	Variable refrigerant flow
VRV	Variable refrigerant volume

2.0 BUILDING MANAGEMENT SYSTEMS

2.1 General

The works shall include design, supply, installation, and commissioning of nominated control systems to achieve the performance specified in the following clauses hereafter referred to as BMS. All BMS infrastructure shall be connected directly the Engineering Technology System VLAN using UNSW supplied data ports and shall conform to the ASHRAE Standard 135-2020 BACnet protocol using BACnet® compliant BTL® listed hardware and software to meet the system's functional specifications. The integrated multivendor BMS network and associated interconnected campus, facility and building systems shall be referred to in the following document hereafter as the Engineering Technology System.

2.2 Nominated Original Equipment Manufacturer (OEM) Products

Only the following nominated OEM products and local distributors shall be used for capital construction works:

- WebCTRL® – Logical Building Automation Pty Ltd
- StruxureWare® – Schneider Electric Buildings Australia Pty Ltd
- Enterprise Buildings Integrator (EBI) - Honeywell Building Solutions

Where BMS infrastructure is being implemented in any new or existing building/facility it is essential that EM Engineering is engaged for OEM products proposed to ensure the integrity of incumbent system within existing buildings is maintained.

2.2.1 Project Kick-off and Engagement

The Estate Management engineering (EM Engineering) technology team must be engaged at the conception of each new project and at the stages noted throughout this document via email at: engtech@unsw.edu.au

The initial project engagement email from the primary point of contact should follow the below template:

TO: engtech@unsw.edu.au
SUBJECT: EM INITIAL ENGAGEMENT_<PROJECT NAME>
BODY: Hi Estate Management Team, Please be advised that <Project Name> has commenced with the following scope elements: - <Scope element 1> - <Scope element 2> - … - <Scope element X>

The project is currently working towards the following program:

<indicative program delivery, shop drawings & asset register submittals, and construction dates>

To inform the design, please advise on the following:

1. Nominated OEM Vendor:
    a. Vendor specific requirements and graphical standards.
2. Network allocations:
    a. Static IP Address for BMS network interface
    b. IP Addresses, Subnets, UDP/IP Port Numbers for LSS
3. Access for the following resources to the portal for software and documentation back-up files and supporting resources to be uploaded:
    a. Resource 1 – Name & Email Address

ATTACHMENTS:

- Concept schematic for approval

2.3 Standards & Reference Material

The BMS shall be installed complying with all:

- National and local statutory regulations
- Occupational Health & Safety legislation and codes of practice
- SAA Wiring Regulations (AS3000)
- AS/CA S008 Requirements for Customer Cabling products
- AS/CA S009 Installation requirements for customer cabling (wiring rules)
- Building Code of Australia
- OEM instructions and recommendations
- ASHRAE Standard 135 BACnet

2.4 Physical Assets

The BMS physical infrastructure shall comprise of the required hardware components to support a single BMS for the entire project. All BMS hardware and software provided a shall be installed to the OEM standards.

All materials and products used shall be new and current generation OEM products commercially available for a minimum of five years after project completion. Untested products shall not be used, unless explicitly approved by the EM Engineering in writing.

2.4.1 BMS Enclosures

All BMS hardware controllers, transformers and relays, power supplies, and other hardware devices associated with the BMS shall be contained within dedicated BMS enclosures fitted with a chrome Quarter Turn 8mm Square Lock.

Enclosures located externally or within plant areas shall be minimum IP54 rated to suit the environment, colour grey.

Enclosures confined within ceiling voids or similar environments shall be within plastic enclosure.

Enclosures containing BMS LAN equipment shall consider ventilation to maintain operable temperatures.

To limit access of electrical/control assets to qualified and authorised personnel, physical separation is required between unprotected low voltage (LV) conductors and extra low voltage (ELV) equipment (as defined in AS/NZS 3000 and under the WHS Act/Guidelines). This should take the form of a physically separate enclosures. Where spatially constrained, and LV supplies are collocated within cabinets, non-conductive covers to be provided with universal tool keying and LV warning labels.

BMS controllers shall not be located within mechanical or electrical switchboards unless approved by EM Engineering.

2.4.2 Labelling and Asset Tagging

BMS enclosures shall be labelled with:

- BMS Panel and Controller name
- Details of incoming electrical supply of the enclosure including location, name of board origin, circuit number, and rated voltage
    - If voltage exceeds 240V, DANGER label to be installed.
- BMS vendor name and contact details
- All input/output wiring connections to sensors, devices, field located controllers, etc shall include termination labels.

Each field device shall be labelled with its unique identifier and the BMS cubical/controller identification number that it is connected to.

All labels must be machine generated using indelible ink ribbons or cartridges. Labels shall be produced by an approved label maker (Brother, Dymo) or otherwise engraved on self-adhesive black text on white Traffolyte.

Label to be fixed to the front of the enclosure.

2.4.3 Wiring

All I/O to BMS enclosure wiring shall use point-to-point cables of a continuous length. No multi-core cables shall be spliced or joint in any form.

2.5 Network Topology

The system architecture shall extend the existing network topology to logically extend the overarching BMS network. Required hardware and software components shall be networked together to provide a system of connected devices that operate as a single BMS for the entire project and integrate without adverse effect to the engineering technology system. The local BMS network should be capable of maintaining functionality in the event of a wider network failure.

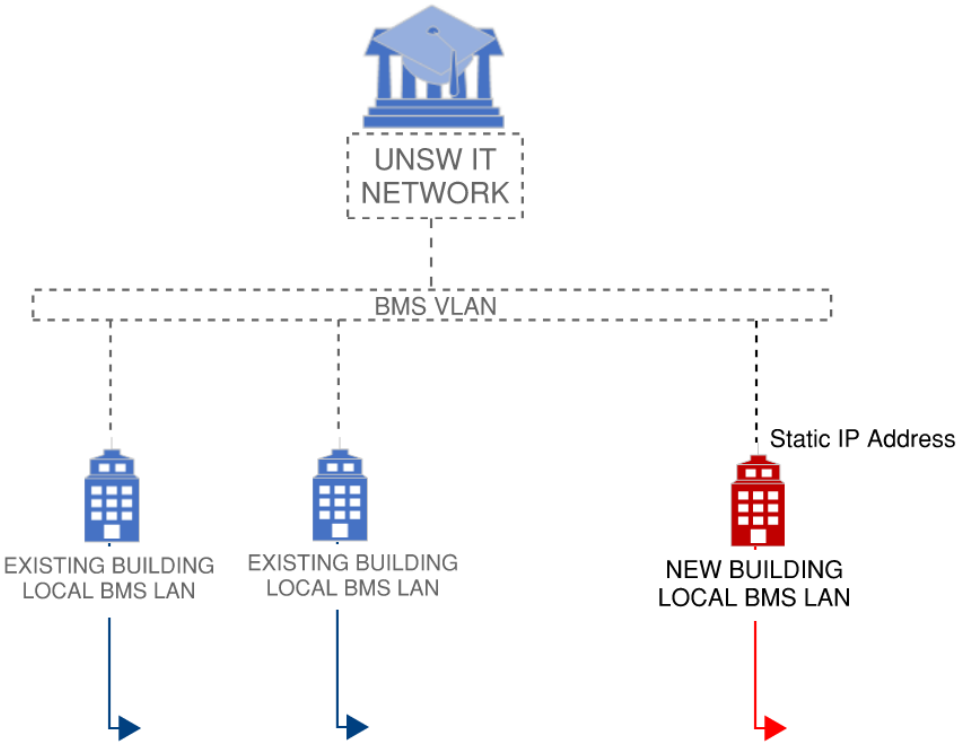


Figure 1 – BMS LAN relative to overarching BMS VLAN supported by UNSW IT Network.

2.5.1 IT Network Interface

The BMS network will interface with the existing BMS VLAN via a static IP address provided by EM Engineering and UNSW IT.

The dedicated BMS TCP/IP Ethernet Network will be connected to the engineering technology system network and nominated VLAN via ethernet data ports provided by the University IT Unit.

Network configuration including IP Addresses, Subnets, UDP/IP Port Number, MS/TP Network Number, Network Number and Device Instances will be supplied by EM Engineering upon approval of the initial BMS network schematic or topology.

NOTE: It shall be the responsibility of contractors to ensure that the BMS design interconnects with engineering technology system and the University IT network to achieve full system functionality, without impact to other BMS and engineering technology system infrastructure. The initial BMS network topology or schematic is required for approval by EM Engineering prior to project commencement.

2.5.2 TCP/IP Ethernet Network

Dedicated BMS TCP/IP Ethernet Network and associated managed devices shall be provided by the incumbent contractor connecting all BMS and subsystem hardware at the building level enabling communication and functionality as a stand-alone system. Device numbers on a network or subnet shall be the lesser of that determined by the by the OEM standards, or the number of devices that will not impact or degrade overall system performance. TCP/IP Ethernet Network speeds shall be set to operate at the maximum speed specified by the OEM documentation and that determined by connected equipment.

The BMS LAN must exclusively use edge switches, no managed switches will be accepted. The LAN topology shall avoid circular networks or ring topologies.

2.5.3 Field Network Configuration

Field Network MS/TP, Modbus RTU, and approved others shall be wired to the OEM standards.

Star or tee connections are not permitted unless recommended by the OEM. Field Network speeds shall be set to operate at the maximum speed specified by the OEM documentation and that determined by connected equipment.

All MS/TP and Modbus RTU communication cables shall be Belden cables (or approved equivalent).

NOTE: Field Controllers and HLI devices shall have separate dedicated MS/TP networks; mixed field networks are not acceptable. Critical Plant and Infrastructure, User Equipment and HLI devices shall have dedicated MS/TP and power segmented from other non-critical devices. The initial BMS network architecture or topology is required for approval by EM Engineering prior to project commencement.

2.5.4 BMS LAN

Unless otherwise specified, or prior written approval has been received from the EM Engineering team, all BMS LAN network cabling works shall be completed in accordance with Section E.4 – Communications standards.

Cabling

All dedicated TCP/IP Ethernet Network cabling shall be Cat 6A STP and sheath purple in colour.

Product samples/data sheets of the following shall be provided for approval and compliance with the selected OEM solution:

- Active equipment
- Equipment enclosures
- Cabling

All cabling shall be completed by licensed contractors with works completed by vendor-approved installers.

Prior to testing, certification of calibration shall be provided to EM Engineering.

100% of installed cables shall be tested. Testing equipment and procedures shall be undertaken in compliance with Section E.4 – Communications standard.

PDF and native test results shall be provided on completion. Any test resulting in a FAIL or PASS* (marginal pass) must be re-terminated and re-tested to achieve a PASS result.

Containment & Enclosures

Where possible, BMS LAN cabling shall be coordinated with the Communications Trade to share containment pathways. Where new separate BMS LAN containment pathways are provisioned, primary pathways shall be sized to support 60% spare capacity.

BMS LAN networking equipment to have dedicated space within BMS enclosures.

2.6 Supporting Services

2.6.1 Power Supply

All power for BMS equipment shall be from dedicated circuits. BMS installations shall be fed from Essential Services supply with generator back-up (where applicable). All Voltage Transformers shall be located within dedicated control enclosures. Separate Voltage Transformers shall be used for each BACnet Network Segment. I/O field peripherals and control peripherals shall be separately powered from the BACnet Network Segments. Power shall not be obtained by tapping into miscellaneous circuits that could be inadvertently switched off.

2.6.2 Uninterruptable Power Supply (UPS)

BMS installations shall be installed with APC Smart-UPS (or approved equivalent) located in a designated 240V/BMS power panel adjacent to the designated control enclosure. UPS and bypass shall be monitored to indicate main and UPS fault conditions and be alarmed on the BMS.UPS shall be installed with an automatic bypass switch to mains power in the event of UPS failure, and to support manual switching for maintenance and replacement purposes.

2.7 Software

All operating software including but not limited to system software, licenses, administration level passwords, drivers, registration details, backups etc. shall be submitted to EM Engineering to the provided portal. Operator Interface Software shall be on existing engineering technology system servers provided by UNSW which are remotely accessible, and on a mobile platform as such terminal PC's and physical user interfaces are not required unless otherwise specified.

2.7.1 Engineering Code/DDC

Software tools required to access, review and/or edit engineering code for all installed equipment shall be provided and installed on engineering technology system servers and/or workstations.

2.7.2 System Passwords

Temporary administration level passwords for Operating Systems shall be provided by EM Engineering initial project engagement. Default hardware system, application controller, and HLI hardware configuration passwords shall be changed to temporary passwords allocated by EM Engineering. Following project handover, temporary passwords will be changed by EM Engineering. Should future access be required during the DLP period to access, review and/or edit Engineering code/DCC, a new password must be requested from EM Engineering.

2.8 BACnet Configuration and Naming Convention

2.8.1 BMS Hardware

BMS hardware (controller) naming descriptions are to be pre-fixed with the UNSW building grid reference, followed by the item location room code, followed by the function/plant served.

Example: *D26_8 Q05_Chilled_Water _Plant _Control*

- Building Pre-fix: D26
- Room Code: 8Q05
- Plant/Component: Chilled_Water_Plant_Control

2.8.2 Point Database

Physical I/O and software point database naming descriptions are to be pre-fixed with the UNSW building grid reference, followed by the plant/component type, and point description. All hardware and software points are to have point names descriptive of the associated equipment or software point to form the point database.

Example: D26_Exhaust-Fan-3.2_Enable

- Building Pre-fix: D26
- Description: Exhaust Fan
- Data Point Reference: 3.2
- State: Enable

***NOTE*:** Points Lists must be submitted for approval by EM Engineering prior to project commencement.

2.8.3 Trend-logs

Trend-logs are to be set up on all general system inputs, variable set points at a fifteen (15) minute period, with operational outputs trended on Change Of Value (COV) for 12 months, after which time the trend data shall be archived to the appropriate Server. Critical system trend-logs are to be set up on all system inputs, variable set points, and binary and variable outputs at a five (5) minute period for 12 months, after which time the trend data shall be archived to the appropriate Server. Trend-Log point description shall be in-line with the Point Database (2.8.2) naming convention.

2.8.4 Time Schedules

Upon initial setup, the following schedules shall be programmed for each facility, with separate scheduling for each building, floor, area and plant.

Table 3 Time Schedules Matrix

Schedule Type	Schedule Description	Schedule Timing
Norm	Normal Schedule	8:00am – 6:00pm
Ext1	Extended Schedule 1	8:00am – 9:00pm
Ext2	Extended Schedule 2	7:00am – 10:00pm
LO	Cooling/Heating Plate Lockout	9:00pm – 7:00am
Crit	Critical Schedule	24 hours

Additional Time Schedules shall have point names descriptive of the associated equipment, device, or software point, to form the point database. Time Schedule descriptions are to be pre- fixed with the UNSW building grid reference, followed by the plant/component type. Time Schedule point description shall be in-line with the Point Database naming convention.

*<Building Pre-fix>*_<Schedule Type>_*<Room Code>*_*<Component>*

2.9 Alarm Management

UNSW's Alarm Management is structured to separate operational and critical events. All alarms shall be categorised and configured as directed by EM Engineering. All alarms shall be BACnet alarms and exposed to the relevant network.

Alarm descriptions are to be pre-fixed with the UNSW building grid reference, level, room code, by the plant/component type, alarm description, and fault type.

*<Building Pre-fix>*_*< Room Code>*_*<Plant/Component>*_*<Alarm>*_*<Fault>*

All alarms are to have point names descriptive of the associated equipment or software point. Alarm/Fault/Alert point description shall be in-line with the alarm type naming convention e.g.C27_ L4401_Chiled-Wate_Temp-Alm_WF01A

2.9.1 BMS Health Alarm Management

BMS Health alarms shall be configured for BMS infrastructure to indicate component communications loss or power failure. All alarms are to have point names descriptive of the associated equipment or software point. Alarm/Fault point description shall be in-line with the Point Database naming convention.

2.9.2 Analytics/FDD Alert Management

Analytics and Fault Detection Diagnostics (FDD) alerts shall be configured for plant and/or condition variables providing indication on abnormal operation. Analytics/FDD points shall be BACnet alarms exposed to the engineering technology system's network. All alerts are to have point names descriptive of the associated equipment or software point. Fault/Alert point description shall be in-line with the Point Database naming convention.

2.10 Integrated Components & Sub-System Interfaces

Integrated components and systems make up a considerable portion of the BMS control and monitoring, with hardwired LLI and communication HLI as the interconnection mediums.

NOTE: Alternative or equivalent integration options shall be explicitly approved by EM Engineering in writing.

2.10.1 Bulk Tank Storage

Bulk Tank Storage System conditions shall be BMS monitored via Modbus RTU HLI, or LLI if not available.

2.10.2 Building Electrical Systems

Electrical systems shall be BMS monitored via BACnet MS/TP or Modbus RTU HLI.

2.10.3 Essential Services Circuit Breaker Monitoring

Critical and research-intensive buildings shall have voltage loss and trip of essential services circuit breakers BMS monitored via BACnet MS/TP or Modbus RTU HLI.

2.10.4 Thermal Energy Meters

Energy Meters shall be installed for each individual chiller and boiler, with secondary and/or tertiary water circuits separately, detailing Kilowatt Refrigeration (kWr), Flow Rate (L/s), and Plant Coefficient of Performance (COP). Flow meters using BMS supply and return sensors to calculate energy shall not be accepted.

Approved meters shall be of Magflow Ultrasonic type and shall be Siemens UH50 or approved equivalent. Proposed meters shall be chosen to suit the application, static pressure and pressure drop. Connection shall be via BACnet MS/TP or Modbus RTU HLI. Alternative products shall be approved by EM Engineering in writing.

2.10.5 MCC Electrical Energy Meters

MCC electrical energy meters shall be of Type 1. Connection shall be via BACnet MS/TP or Modbus RTU HLI. Any electrical meters monitored via the BMS shall have the capability to expose the meters to the UNSW engineering technology system via Modbus TCP/IP.

Reference Appendix 7 – UNSW Energy Management Metering Requirements, relating to EMACS for metering functionality.

2.10.6 Utilities Metering (EMACS)

Contractors must note the details given in **Appendix 7 – UNSW Energy Management Metering Requirements**, relating to EMACS for metering functionality.

2.10.7 Fire Systems

Fire systems monitoring shall be BMS monitored via Modbus RTU HLI. Please refer to **Section E.3.3 Special Systems** for approved FIP solutions.

2.10.8 Fume Cupboards

Centralised building wide Fume Cupboard installation monitoring shall be BMS monitored via BACnet MS/TP or Modbus RTU HLI. Where small Fume Cupboard's numbers are specified, LLI fault, status and sash position monitoring shall be provided.

2.10.9 Generators

Generators shall be BMS monitored via or Modbus RTU.

2.10.10 Heating Ventilation & Air Conditioning Plant

HVAC equipment including, but not limited to Chillers, Boilers, and VSDs shall be BMS controlled via LLI and monitored via a BACnet MS/TP or Modbus RTU HLI.

2.10.11 Hydraulic Systems

Hydraulic Systems shall be BMS monitored via Modbus RTU HLI, or LLI if not available.

Bore water systems shall conform to Section E.1 Hydraulic Services.

2.10.12 IAQ Sensors

Indoor Air Quality (IAQ) Sensors with Temperature, Humidity and CO2 shall be used as a minimum standard for all zone or room space sensing regardless if the sensors are used for plant control and shall be graphically represented on a floor plan. Additional sensors may be included depending on the application and control requirement.

2.10.13 IoT Sensors

BMS shall interface with IoT Sensors via BACnet or approved HLI/API and be graphically represented on a floor plan. BMS control functions from IoT sensors shall be edge based, not cloud based via the local BACnet gateway.

2.10.14 Laboratory Air Management Systems

Laboratory Air Management Systems shall be BMS monitored via BACnet MS/TP or Modbus RTU, on an independent network and power segment and shall not be mixed with the BMS network.

2.10.15 Lift Systems

Lift system operations will consist of local lift monitoring system and BMS interface for local lift monitoring.

Passenger and Goods lifts shall have basic alarms and faults monitored by the UNSW BMS. In buildings that contain four (4) or more lifts, additional features are to be monitored with a dedicated Local Monitoring System (LMS).

All lifts and escalators are to have certain functions monitored by the BMS

Refer to **Section E.5 UNSW Lift Design Standards** for full details of lift monitoring requirements.

2.10.16 Lighting Systems - Internal

BMS shall monitor internal lighting systems via approved BACnet HLI, and be graphically represented on a floor plan.

PIR monitoring shall be via BACnet or approved HLI (refer to 2.11.8).

Refer to **Section E.3.2 Lighting** for system requirement details.

2.10.17 Lighting Systems - External

External Lighting shall be via the Schneider StruxureWare® product only and be integrated to the Campus Wide External Lighting System.

2.10.18 People Counting Systems

BMS shall interface with People Counting systems via approved HLI, and be graphically represented on a floor plan (refer to 2.11.8). People counting devices shall use the Axis product range. Alternative products shall be approved by EM Engineering in writing.

2.10.19 Uninterruptable Power Supplies (UPS)

Centralised building wide UPS monitoring shall be BMS monitored via BACnet MS/TP or Modbus RTU HLI. Distributed UPS's shall be monitored via LLI.

2.10.20 VRV/VRF DX Air Conditioning Systems

VRV/VRF DX Air Conditioning Systems shall be integrated into the engineering technology system. VRV/VRF systems shall only be BACnet monitored in critical applications, or where the VRV/VRF component makes up a considerable component of the HVAC system. In critical applications where small VRV/VRF unit numbers are specified, Indoor Unit interface cards shall be used to provide LLI control and monitoring via the BMS. Submit proposed VRV/VRF systems to EM Engineering for endorsement.

Refer to **Section E.2 – Mechanical Services**.

2.10.21 Differential Pressure Sensors

Differential pressure sensors (not switches) shall be provided to all filters.

2.10.22 Temperature Well Probes

Temperature well probes to have direct contact within the inner temperature well wall and treated with thermal paste rated for the anticipated temperature range. Existing thermal paste to be removed and cleaned prior to reapplication.

2.11 Control System Functionality

In addition to or in line with the project design intent, the following system functionality and components shall be provided and programmed for each BMS installation to assist building tuning, operational functionality and energy use.

2.11.1 Actuator Position Monitoring

Actuators with position feedback monitoring shall be provided for all air side plant. FDD shall be created and alarmed for operational deficiencies (refer to Section 2.8.6).

2.11.2 Automatic Lockout Resets

Plant alarm/fault/failure software lockouts shall automatically reset and not require reset via the BMS. Plant shall have the functionality to restart once the local plant/machine alarm/fault/failure condition has been cleared.

2.11.3 Cooling and Heating Plant Staging Strategies

Energy Meters referencing plant loads and conditions shall be used to stage cooling and heating plant (refer to Sections 2.9.4 and 2.9.5).

2.11.4 Global Override Modes - Zone Temperature Set Point Adjustment

Zone temperature set point override shall be provided for air side plant via the graphical interface for each installation. Deselection functionality shall be provided for individual terminal.

2.11.5 Global Override Modes – Chilled & Hot Water Valves

Global override of chilled and hot water valves for air side plant shall be adjustable via the graphical interface for each installation.

2.11.6 Maintenance Mode – Main Plant

Major plant shall be graphically selectable for Maintenance Mode, where selected plant will be omitted from staging, sequencing and operation.

Maintenance mode shall be clearly defined via the graphics, and associated alarms shall be disabled.

2.11.7 Manual Staging Control

Central plant shall have functionality to manually stage plant as an operator from the graphical interface.

2.11.8 Occupancy & After-Hours Air Conditioning (AHAC)

All Air Side Plant and Terminal Units shall have occupancy control via Lighting System integration, IAQ sensor integration, IoT sensor integration or EM Engineering approved HLI.

2.11.9 Rogue Zone De-Selection - Building Cooling/Heating Call

Building Cooling and Heating Calls shall be graphically represented detailing control parameters. Chilled Water Valves, Heating Water Valves and Electric Duct Heaters shall be selectable for addition/subtraction to the building heating and cooling calls to omit rogue zones. Selection shall be made available via equipment summary graphics.

2.11.10 Rogue Zone De-Selection – Air Side Plant Demand

All Terminal Units and VAV's shall be selectable for addition/subtraction to the main plant temperature and/or pressure demand to omit rogue zones. Selection shall be made available via equipment summary graphics

2.11.11 Supply Air Temperature Monitoring

Supply air temperature sensors shall be provided for all air side plant. This includes downstream temperature monitoring of main air side plant, terminal units, EDHs etc. EDHs shall additionally be monitored via current transducer (CT) switches to confirm operation. Additional Off-Coil sensors shall be installed where dew point, or humidity control is required to verify operation. FDD shall be created and alarmed for operational deficiencies (refer to Section 2.8.6).

2.11.12 Setpoint Reset Strategies

Temperature and pressure Setpoint Reset Strategies shall be applied where possible based on building/plant loads for cooling, heating and air side plant.

2.12 Graphical Standards

Graphics standards shall be in-line with the current format of the nominated BMS OEM products and shall include:

- Intuitive navigation shall be provided for point and click active link to access inputs, outputs, trend logs, schedules, alarms, control loops, and all other virtual or physical control points.
- Interface with campus wide navigation menu – accessible from all graphics.
- All systems plant/components serving a space or area shall be represented on a single graphic where possible e.g. PC2 lab with various supply and extraction plant/components on a single graphic representing operation of all plant/components, total air flow and pressure regime and for the lab.
- Layer control shall be used to represent all BMS system and sub-system operational functionality.
- Air and water schematics graphics shall be used and correctly represent operational functionality as-built systems.
- Total Cooling/Heating Call management shall be graphically represented.
- Floor plans shall be graphically displayed with a navigational directional key for orientation. Plans must show at a minimum:
    - All spaces, room numbers, and room outlines
    - Controlled plant/equipment/BMS panel locations and running/fault status
    - Sensor zones (temperature, RH, CO2, pressure etc.)
- Each Installation shall have graphical links to O&M Documentation set and associated 'As-Built' workshop drawings for mechanical, electrical and hydraulic trades.
- All graphics shall be accessible through the incumbent web interface using HTML and have links to each asset.
- Graphics shall indicate when input/output parameters are forced.

NOTE: Sample graphics shall be provided for approval by EM Engineering during the FAT stage prior to final graphics implementation.

2.12.1 Equipment Graphics

Each piece of equipment shall be represented by an individual graphic with the following:

- Name, area served, location, inputs, outputs and operating parameters,
- A link to the settings page with adjustable settings/parameters including reset setpoint parameters, PID loop settings, economy settings, optimum start/stop settings, on/off and force valve/damper/speeds outputs.
- A display of the associated time schedule which adjusts according to changes,
- Trend charts shall be made available for display of data relevant to each piece of equipment verifying the systems performance.

2.12.2 VAV Summary Graphics

VAV summary graphics shall show the following:

- Name, area served, zone temp, temp set point, mode, damper position and terminal load,
- Airflow: max airflow set point and active airflow set point
- Reheat valve and supply air temperature if applicable
- Tick box to include VAV from calculations.

2.12.3 AHU Summary Graphics

AHU summary graphics shall show the following:

- Name, area served, valve positions and fan speed
- Supply pressure, supply pressure set point, supply air temperature and supply air temperature setpoint
- On/off status

2.12.4 Chilled Water and Heating Hot Water Graphics

Chilled water and heating hot water graphics established per building shall show the following:

- Valve position,
- Cool/heat call value,
- Call on valve position
- Call off valve position
- Enable tick box to include/exclude call from programming

3.0 LIFE SAFETY SYSTEM

3.1 General

This section shall be used as a guideline for the architecture of Life Safety Systems (LSS) at UNSW, and the requirement for integration of the electronic LSS into the building/facility BMS and engineering technology system only. LSS hereafter refers to the electronic sensing, alarm devices, and programmable controllers-based infrastructure associated with Life Safety Systems and gas detection and Monitoring systems.

The LSS shall be designed as a de-centralized system so that any Lab, Zone, or Facility and its associated LSS infrastructure can be isolated, maintained or serviced without interruption to surrounding Labs, Zones, or Facilities. Individual SIFs shall have the ability to be independently managed, calibrated, isolated and changed without impact to other SIFs or components of the LSS.

LSS shall include design, supply, and installation of LSS hardware and software, sensors, Programmable Controllers, Safety Relays, HMIs and panels. FAT and SAT validation of the system shall meet the requirements of the Cause and Effect Matrix developed through the HAZID, HAZOP study and SIF and SIL determination.

Where LSS infrastructure is being implemented in an existing building or facility it is essential incumbent products are used as an extension to the existing LSS.

NOTE: Refer to project specific standards, HAZID, HAZOP studies, relevant UNSW hard services specifications and project specifications for holistic LSS mechanical, hydraulic and electrical system details and requirements.

NOTE: The content on these guidelines is for general information and general UNSW requirements only and is NOT a system design or installation advice. A full risk assessment must be conducted during design to determine the system safety integrity level, best location, number and type of detectors and devices in any installation.

3.2 Standards and Reference Material

The LSS shall be installed complying with all:

- National and local statutory regulations.
- Occupational Health & Safety legislation and codes of practice.
- SAA Wiring Regulations (AS3000).
- Electrical installations - Selection of cables for alternating voltages up to and including 0.6/1 kV (AS/NZS 3008)
- Building Code of Australia.
- Original Equipment Manufacturers (OEM) instructions and recommendations.
- AS4641 Test methods for toxic and oxygen gas detectors.
- AS/NZS 60079.14 Explosive atmospheres - Electrical installations design, selection.
- AS 60079.29 Parts 1,2,3 Explosive Atmospheres - Gas Detectors.
- AS 61508 - Functional safety of electrical/electronic/programmable electronic safety.
- AS 61511 - Functional safety - Safety instrumented systems for the process industry sector.
- AS/CA S009 - Installation requirements for customer cabling (Wiring rules).

3.3 Physical Assets

3.3.1 LSS Components

LSS components shall be selected to meet the requirements of the Specification, and Cause and Effect Matrix developed through the HAZID, HAZOP study and SIF and SIL determination to ensure the minimum SIL level is met. All materials and products used shall be new and current generation OEM products commercially available for a minimum of five years after project completion. Untested products shall not be used, unless explicitly approved by EM Engineering in writing.

3.3.2 LSS Field Devices

- Emergency Stop Buttons
- Anunciation devices (Sound and Strobes)
- Floor Leak detectors
- Safety Devices required as per Cause-and-Effect Matrix

3.3.3 LSS Control Panels

All Control panels shall include Tower light with sound alarm, mute button and Emergency stop button.

LSS Programable Controllers

A Safety PLC should be used as an integral part of a Safety Instrumented System (SIS), this should be Siemens or approved equivalent accepted by EM Engineering.

LSS Gas Detection Controllers

Gas detection controllers shall be Honeywell Touchpoint, Drager Regard or approved equivalent accepted by EM Engineering so long as the selected product complies with the specification and safety design.

3.3.4 Mean Time to Repair (MTTR)

For verification of SIL design, a MTTR of less than forty (40) mins shall be used.

3.3.5 Labelling and Asset Tagging

All wall mounted EMO and field LSS devices shall be labelled using self-adhesive engraved Traffolyte labels.

Labelling shall follow a standard convention of LSS - *SENSOR TYPE - ROOM NUMBER + ID NUMBER*

Example: LSS-SENSOR-O2-RM345+ID21

Sensor types will be determined using the table below:

Table 4 Sensor Types

Standard Naming	Sensor Type
LSS-SENSOR-CO	Carbon Monoxide
LSS-SENSOR-CO2	Carbon Dioxide
LSS-SENSOR-F2	Fluorine
LSS-SENSOR-LEL-CH4	Methane
LSS-SENSOR-NH3	Ammonia
LSS- SENSOR-LEL-H2	Hydrogen
LSS-SENSOR-O2	Oxygen
LSS-SENSOR-FLD	Floor Leak Detector
LSS-SENSOR-Pressure	Pressure
LSS-SENSOR-Temp	Temperature
LSS-EMO	Emergency Off Button

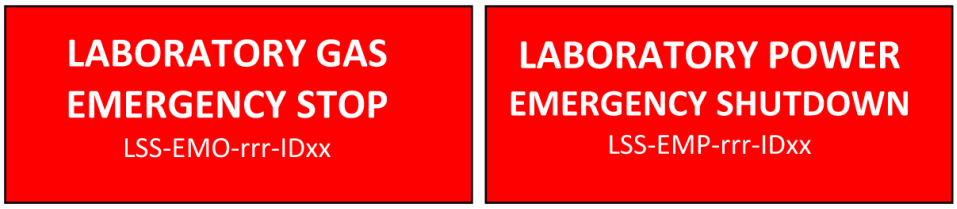
LSS-EMP	Emergency Power Off
LSS-GMP	Gas Monitoring Panel
LSS-CP	Control Panel
LSS-ALARM	Audible Beacon
LSS-GASCABC	Gas Cabinet Controller
LSS-LIGHT	Strobe or Tower light

Wall-mounted EMO

Labels specifications:

- Label size: 80 x 35mm
- Font size: 20 bold (top text), 14 (bottom text)
- Label background colour (RGB): 255, 80, 80
- Font colour: White

Example:

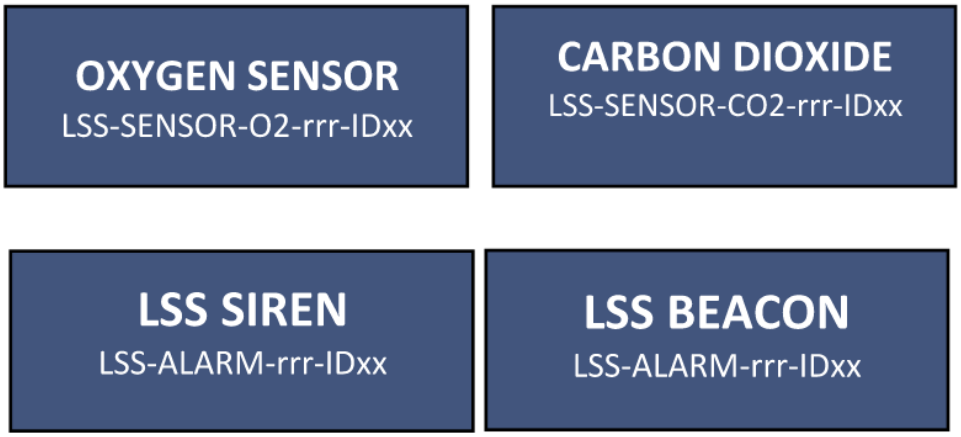


All Other Devices

Labels specifications:

- Label size: 50 x 20mm
- Font size: 14 bold (top text), 11 (bottom text)
- Label background colour (RGB): 67, 86, 125
- Font colour: White

Example:



3.4 LSS Architecture

The system architecture shall comprise of LSS panels or nodes networked together to operate in a de-centralized topology, where any SIF, node and/or component of the LSS can be isolated, maintained and changed without adverse effect to other SIFs, panels or nodes on the network.

The System should be able to put systems in Maintenance or lock-out via HMI password protected.

3.4.1 Network Topology

LSS Safety networks shall be installed independent to UNSW's IT network.

Where LSS User Interface PCs are required, network configuration including IP addresses, subnets, and UDP/IP port numbers will be supplied by EM Engineering upon approval of the initial LSS network architecture or topology. All LSS ethernet CAT6 cable sheaths shall be yellow in colour. LSS Panels shall be interconnected using common industry Field Bus protocols including but not limited to Modbus, Profibus, Safety Ethernet etc. on network infrastructure as per OEM requirements, network standards, and relevant Australian Standards.

Copper cabling installations shall be as per Section 2.5.4.

3.5 Supporting Services

3.5.1 Power Supply

All power for LSS equipment shall be from dedicated circuits. LSS installations shall be fed from Essential Services supply with generator back-up (where applicable). Power shall not be obtained by tapping into miscellaneous circuits that could be inadvertently switched off.

3.5.2 Uninterruptable Power Supply (UPS)

All LSS panels and field devices must be connected to a UPS system.

LSS installations shall be installed with UPS located within or adjacent to the designated control enclosure to supply power to all components if centralised building UPS is not specified with greater than thirty (30) minute battery life to power all LSS components. UPS shall be monitored to indicate fault condition and alarmed on the LSS.

3.6 Software & Operator Interface Hardware

Where LSS hardware and User Interface PCs are required Network configuration including IP Addresses, Subnets, and UDP/IP Port Number will be supplied by EM Engineering upon approval of the initial LSS network architecture or topology. All LSS hardware and software shall be configured to current UNSW naming conventions in-line with the UNSW building grid references. IP addresses, subnet configuration, device instances, network numbers, port numbers etc.

All software shall be configured to current UNSW naming conventions in-line with the UNSW building grid references. IP addresses, subnet configuration, device instances, network numbers etc. are available from UNSW Estate Management Engineering upon request. All operating software including but not limited to system software, licenses, administration level passwords, drivers, registration details, backups etc. shall be submitted to EM Engineering on approved media.

All operating software including but not limited to system software, licenses, administration level passwords, drivers, registration details, backups etc. shall be submitted to EM Engineering to the provided portal. Operator Interface Software shall be on existing engineering technology system servers provided by UNSW which are remotely accessible, and on a mobile platform as such terminal PC's and physical user interfaces are not required unless otherwise specified.

3.6.1 Software

All operating software including but not limited to system software, licenses, administration level passwords, drivers, registration details, backups etc. shall be submitted to EM Engineering.

Operator Interface Software shall be on existing engineering technology system servers provided by UNSW which are remotely accessible, and on a mobile platform as such terminal PC's and physical user interfaces are not required unless otherwise specified

3.6.2 Engineering Code

Software tools required to access, review and/or edit the Engineering Code and system configuration for all installed equipment shall be provided.

All operating software including but not limited to system software, licenses, administration level passwords, drivers, registration details, backups etc. shall be submitted to EM Engineering to the provided portal

3.6.3 System Passwords

Temporary administration level passwords for Operating Systems shall be provided by EM Engineering initial project engagement. Default hardware system, application controller, and HLI hardware configuration passwords shall be changed to temporary passwords allocated by EM Engineering. Following project handover, temporary passwords will be changed by EM Engineering. Should future access be required during the DLP period to access, review and/or edit DDC/Engineering code, the new password must be requested from EM Engineering.

3.7 Point Database

Point naming descriptions are to be pre-fixed with the UNSW building grid reference, followed by the plant/component type, and point description. All points are to have point names descriptive of the associated equipment or software point to form the point database.

Example: E26_619_Oxygen Depletion

- Building Pre-fix: H6
- Room Code: 619
- Description: Oxygen
- State: CRITICAL_ALARM

3.8 Alarm Management

3.8.1 LSS Control Panel

Each Lab, Zone or Facility shall have a touch screen HMI alarm management, notification and annunciation panel. Floor Level HMI shall be installed where large numbers of Labs/Zones are localised.

HMI should indicate location of the sensors associated to the LSS Gas Monitoring system. The HMI interface shall include the following information as a minimum:

a. System Overview (including Room Numbers)

b. Zone Alarm

c. History Trending

d. System Status / Alarm History

e. Sensor Status and Readings

f. Connectivity

g. Malfunction Alarm

h. Calibration Mode

3.8.2 Audible and Visual Alarms devices

The LSS shall trigger all Audible Alarms associated with life safety functions. Audible alarms in high noise areas shall be rated for the dB levels present and shall be adjustable.

The LSS shall trigger all Visual Alarms stacks and strobes associated with life safety functions. Outdoor strobes shall be designed for visibility in daylight conditions.

A tower light located at the control panel should indicate the follow conditions:

- Red – Alarm Status
- Ambar – Warning / Maintenance
- Green – Normal Status

3.9 Integrated Components & Sub-System Interfaces

3.9.1 High Level Interface

The LSS shall provide HLI communication to be connected to the UNSW EM Engineering LSS central interface infrastructure via Modbus for data transmission and monitoring of LSS alarms, sensor values and fault conditions.

NOTE: Alternative or equivalent integration options shall be explicitly approved by EM Engineering in writing.

LSS Gas Sensors- Oxygen, Flammable, Toxic Gases

All Oxygen and gas detection sensors supplied shall have a minimum three (3) year life span. Provide sensors accredited for life safety applications where applicable.

Low oxygen sensors or oxygen depletion sensors shall be electrochemical cell type. They shall be suitable for the location they will be installed and shall not be adversely affected by the normal levels of contaminants in the air in these locations.

All CO_2 sensors shall be of the use non-dispersive infrared (NDIR) technology type suitable for gas leak detection applications. Carbon monoxide sensors shall be of the electrochemical two electrode type capable of measuring carbon monoxide in air. Volatile Organic Compound (VOC) sensors shall be of the metal-oxide semiconductor sensing element type.

Emergency Stop Buttons

The LSS shall monitor and control all Emergency Push Button functionality and safety functions. Provide colour coded, mushroom style, Emergency Pushbuttons with Push – Pull action. Emergency Push button shall denote shutdown or interlock information.

Floor Leak Detectors

Floor leak detection sensors should be positioned in areas where fluid spillage can occur realising possible harmful vapours and connected to the LSS.

3.9.2 Low Level Interface

Integrated systems make up a considerable portion of the LSS control and monitoring, with hardwired LLI as the interconnection medium for all safety functions.

NOTE: Alternative or equivalent integration options shall be explicitly approved by EM Engineering in writing.

Field Devices for Safety Functions

All Instrumentation and field devices should be installed by the LSS specialist. Safety functions and interoperability of BMS controlled equipment shall be interfaced between LSS and BMS via hardwired LLI.

Fire Trip

The LSS shall monitor Fire Trip directly from the FIP via hardwired LLI.

Fan Failure

The LSS shall monitor Fan Failure via the BMS or LSS pressure sensors using hardwired LLI.

3.9.3 Safety Alarm Integration

Safety Alarms that are part of a SIF shall be hard wired directly to the BMS via LLI. Safety functions and interoperability of BMS controlled equipment shall use N+1 configuration using multiple points of fault verification to generate an alarm via hardwired LLI in a failsafe wiring configuration.

Safety functionality and alarms include:

- Ventilation Systems
- Room Pressurisation System
- Fire System
- Electrical Safety Systems (i.e. emergency power shutdown)
- Natural Gas Safeguards

4.0 Documentation

Throughout the course of the project proper documentation is be maintained at all stages. This includes the documentation requirements outlined in the following stages of:

- Pre-construction documentation
- As-built
- Integrated System Test Commissioning
- Completion

Printed points list, wiring diagrams and Cause and Effect matrix shall be laminated and mounted within each panel enclosure detailing the revision number and date.

Any changes or additions to the building plant, systems are to be incorporated into the wider building functional description, air or water schematics, LAN schematics and BMS points list.

4.1 Pre-Construction

BMS Pre-Construction documentation shall be submitted for approval by EM Engineering detailing:

- Project Functional Description
    - As-Built Building Functional Description shall be graphically available from the incumbent BMS web interface.
- Improvement, extension or fit out projects Function Descriptions may be submitted for approval separate to the As Built Building Functional Description, however, must be included in the As Built Building Functional Description documentation set at the completion of the project. Project BMS Network Schematic and Asset register
    - Network Schematic shall be graphically available from the incumbent BMS web interface.

- Improvement, extension or fit out projects Network Schematics shall be submitted for approval as part of the complete As Built Network Schematic documentation set.
- Network Schematics shall include detail of IP Ethernet Network, IP addresses, BACnet instances MS/TP and VLAN number settings.
- Asset Register shall be submitted for approval with the Network Schematic detailing IP addresses, BACnet instances MS/TP and VLAN number settings controller numbering, MAC address, model, configuration settings and details, passwords, locations and general information.

- Project BMS Points List
  - As-built Points List shall be graphically available from the incumbent BMS web interface.
  - Improvement, extension or fit out projects Built Points List may be submitted for approval separate to the As-built BMS Points List, however, must be included in the as-built Building Built BMS Points List documentation set at the completion of the project.

4.2 Shop Drawings

Submit proposed installation “shop” drawings with the Operating and Maintenance Manuals prior to the date of practical completion. The drawings shall comprise those required as Workshop Drawings and brought up to date.

4.3 Handover

At practical completion, a complied set of “As-Built” documentation shall be provided to form a complete Operation and Maintenance (O&M) Documentation set. This set shall include all modifications that occurred during the defect liability period. The O&M Documentation set should be provided at handover and shall represent the BMS as a fully furbished system that represents:

4.3.1 As-Builts

These documents shall represent the LSS and the BMS as specified, subject to approved modifications, and include, but not be limited to:

- FAT, SAT, IST, HAZID, HAZOP, Cause and Effect Matrix, SIL Determination.
- Various sub-systems of the LSS.
- System topology - i.e. a schematic diagram showing all HMI and PLC addressing, LAN types and network numbers, MAC addresses and IP addressing.
- The physical location of each node/controller and I/O field device.
- I/O point database.
- Wiring diagrams.
- All system settings for Cause and Effect operation.
- Commissioning and acceptance test details and results.

The above shall be depicted on the system graphics, thus enabling easy accessibility for operational and maintenance needs.

4.3.2 Commissioning and Programming

Building Management System

Commissioning shall be conducted in accordance with CIBSE Commissioning Code C: Automatic Controls, which includes season commissioning that is required to ensure the BMS control loops are fully tuned to cater for all specified design conditions. FAT, SAT and IST validation and shall be included as part of the commissioning process.

Life Safety System

One hundred percent (100%) proof test of every SIF shall be conducted as per AS 61511. Validation and commissioning shall be documented and submitted as part of the O&M. Validations documents should include the controller software checksum at the time of testing.

4.3.3 Practical Completion

Contractors are required to:

- Conduct FAT and SAT to demonstrate and confirm that all systems are programmed and operating correctly in line with the Cause and Effect Matrix. See “Acceptance Testing” below.
    - Document network topology, point database, system configuration and addressing for system communication shall be identified and documented in the commissioning report and incorporated in the Operation and Maintenance Manuals.
    - Document I/O and HLI point databases in the commissioning reports in the Operation and Maintenance Manuals.
    - Source code and software of the system shall be provided via soft copy to UNSW EM.

4.3.4 Acceptance Testing

FAT documentation shall be submitted for review. When the contractor is satisfied with the system design, EM Engineering representative shall be invited to witness Factory Acceptance Testing (FAT), where the operational functionality of all controlled systems shall be reviewed and tested against the design intent and Functional Description. At this time other system functions such as system graphics, trending and alarm generation shall be reviewed. FAT shall be conducted as early in the design process as possible to mitigate any potential non-conformance or failure issues.

At practical completion, an EM Engineering representative shall be invited to witness a Site Acceptance Test (SAT), where the engineering technology system’s network integration and operational functionality shall be reviewed against the design intent and functional description for all commissioned, controlled, and monitored systems and sub-systems. Integrated Systems Testing (IST) will be required for final sign-off and acceptance.

4.3.5 Integrated Systems Testing (IST)

IST shall include all interoperable functionality across all controlled and monitored systems and sub-systems. Alarm functionality and configuration shall be validated and tested as part of the IST. EM Engineering shall be invited to witness an IST in line with the Specification, Functional Description, design intent and Cause and Effect Matrix. IST validation and commissioning shall be documented and submitted as part of the O&M Documentation set.

4.3.6 O&M manuals

Binder Information: Provide the following information:

- Project name and service on the spine.
- Project name and service on the front cover along with the Principal's name, Builder's name, Contractor's name and the Superintendent's name.

Title Page: Provide the name of the Contractor and their address and contact numbers and the expiry date of the Defects Liability Period.

Index: Provide a comprehensive Table of Contents.

General Description: Providing an easy-to-read description of the installation covering all systems and their functions. Reference is to be made to latter and more detailed descriptions of plant or systems. Operating Instructions: For the correct starting, operating, shut down, fault finding, etc. for each system and item of plant, and instructions for adjusting all controls and cut out settings. The instructions are to be put together in such a way as will allow pages to be removed should it be necessary to correct or expand any procedure. Where operation, test or maintenance involves a hazard to personnel or equipment, the description of that action is to be immediately preceded by a warning, caution or note.

Maintenance Instructions: Setting out in detail all requirements for preventative and corrective maintenance of the complete plant. This is to be arranged in tabulated sections of recommended daily, weekly, monthly and annual maintenance in the form of a logbook as described further below. The instructions are to note periodicity, performance standards to be maintained, physical inspections to be performed, cleaning, lubrication, adjustments, special tools required, special materials required, testing procedures, trouble shooting and fault diagnosis procedures, dismantling and assembly procedures.

Manufacturer's Instructions: For maintenance, repair or overhaul for each item of equipment, including calibration of all controls and instruments. These instructions are to be included in the maintenance instructions.

Manufacturer's Literature: Copies of manufacturer's manuals and equipment specific brochures. Originals of the manuals and brochures are to be installed and photocopies will be rejected. The literature is to provide physical details such as size, shape, weight, mounting and securing, interconnection, etc.

Test Records and Commissioning Data: The data is to be typed with the same text format as all other text and is to be contained in ruled, titled tables with an index. Handwritten tables will be rejected. The records will at least contain the results of all performed tests. Sufficient space must be left for Final Tests and other required Tests.

Drawings: "As-Built", complete with index. All drawings for inclusion in the manuals are to be reduced scale reproduction A3 sheets. Care must be taken in the drafting of the drawings to ensure that the reproductions are legible. All drawings are to have a graphic scale as well as a designated scale.

Logbook: Include in the manual, logbook pages set up for recording the maintenance items listed above (operational and maintenance actions and procedures, periodicity, performance standards, adjustments made, materials used, test results, comments for future maintenance actions, notes covering the condition of the installation, etc.), sufficient in number to receive the entries for the maintenance period and for a further period of 12 months. Make entries recording the operational and maintenance activities performed up to the time of Practical Completion of the Contract.

4.3.7 DLP & Warranties

The contractor’s installation warrant shall include on-site repair and/or replacement defect liability period of minimum 12 months. In addition, the liability requirements shall be applicable:

- Emergency call outs
- Project-specific special requirements

4.4 Change Management

The BMS and/or LSS Contractor shall work with the University’s representative to develop a mutually satisfactory change management procedure that will be applied to any changes that affect the BMS, LSS or engineering technology system. The change management procedure shall ensure that:

- No change to alarms or CAMS alarms are made without the written approval of the University
- No control or graphical change is made without the written approval of the University
- No set points are adjusted without written approval of the University
- Every change is fully documented, and O&M manuals are updated as necessary.
- Backup copies of software and documentation shall be made and saved to the UNSW provided engineering technology system NAS.